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(71)(72) Applicant and Inventor: KDER, Miroslav [CZ/CZ]; Lidická 314, 252 66 Libčice nad Vltavou (CZ).

(74) Agent: PATENTSERVIS PRAHA A.S.; Jívenská 1/1273, 140 21 Praha 4 (CZ).

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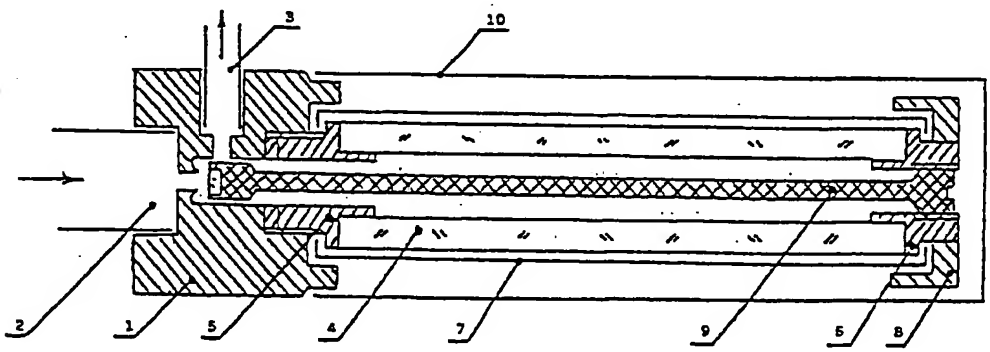

(57) Abstract

A tension controlled pressure reducing valve used in gas pressure control which comprises a diaphragm in the form of a resilient tube (4) with connected faces (5 and 6), further with planchettes (7) placed longitudinally on said tube (4) and anchored in said faces (5 and 6) of said tube (4). Said diaphragm controls movement of a plug (9) with regard to a seat of a throttling device.

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A TENSION CONTROLLED PRESSURE REDUCING VALVE

Field of the Invention

The present invention relates to a tension controlled pressure reducing valve for gas pressure control, particularly useful in the closed circuit breathing apparatuses, with a fixed setting of the secondary pressure.

Background of the Invention

The prior art pressure reducing valves for gas pressure control usually employ a diaphragm or a piston as the controlling member.

They are produced by means of a demanding working process from a forged piece. A diaphragm valve is adjustable by means of adjustable springs. The valves are also provided with the necessary threaded joints and gaskets. The parts of such valve require to be worked precisely. Large-diameter threaded joints are necessary. Consequently, such valves are rather massy.

Accordingly, it is an object of this invention to overcome the problems of the prior art and particularly to provide easy-to-produce, low-weight pressure reducing valves comprising a minimum number of parts.

It is another object of this invention to provide pressure reducing valves that do not require massy forged pieces and the demanding working of such pieces to be produced.

It is yet another object of this invention to provide pressure reducing valves that are easy to set by one element only without any further mechanical operations.

It is yet another object of this invention to provide pressure reducing valves that provide a nearly non-varying static secondary pressure set to a user determined value chosen from the whole range up to the input primary pressure.

Summary of the Invention

The present invention relates to a tension controlled pressure reducing valve for gas pressure control, particularly useful in the closed circuit breathing apparatuses, provided with a fixed setting of the secondary pressure. Said tension controlled pressure reducing valve comprises a diaphragm which diaphragm is in the form of a resilient tube provided with faces connected to said tube. Further, planchettes are placed longitudinally on said tube. Said planchettes are anchored in said tube faces. Said tube controls the distance between a valve plug and a seat of a throttling device.

It is an advantage of the tension controlled pressure reducing valve according to this invention that it overcomes the problems of the prior art. Particularly, the invention provides easy-to-produce, low-weight pressure reducing valves comprising a minimum number of parts. A valve according to this invention does not have any friction surfaces, no lubricating media are used. No massy forged pieces or demanding working are required to produce said valves. The novel pressure reducing valves are easy to set by one element only without any further mechanical operations. Said valves provide a nearly non-varying static secondary pressure set to

a determined value situated anywhere within the whole range up to the input primary pressure.

The range of the secondary pressure can be set to be within the range from the high primary pressure existing in an attached storage steel bottle, e.g. 40 MPa to 30 MPa, to a secondary pressure in the range from 0.1 to 9 MPa, preferably from 0.1 MPa, to 2.0 MPa, more preferably from 0.2 to 1.0 MPa, whereby, the specific secondary pressure value used depends on the system design and the specific use, e.g. by divers, firemen, industry, etc. In case of the diving breathing apparatus the primary pressure can be 30 MPa and the secondary pressure can be 4 to 9 MPa, in an industrial use the primary pressure can be 40 MPa and the secondary pressure can be 0.5 to 4 MPa.

Brief Description of the Drawings

The invention will be further illustrated by means of the attached drawings where

Figure 1 is a view of a schematic illustration of a valve in the position at rest,

Figure 2 is a schematic cross-sectional illustration of a valve in the position at rest,

Figure 3 is a schematic illustration of a valve from figure 1 in the working position when the primary pressure is let in,

Figure 4 a schematic cross-sectional illustration of a valve in the working position and

Figure 5 shows a cross-sectional illustration of the exemplified embodiment of an assembled tension controlled pressure reducing valve.

Detailed Description of the Invention

A tension controlled pressure reducing valve of the present invention of a particularly preferred embodiment comprises a basic body 1 provided with a threaded input opening 2, eventually, with a not shown threaded opening for a signalling device and a pressure gauge for measuring of gas pressure in the primary pressure space. A part of said basic body 1 is also a seat of a throttling device which seat separates said primary pressure space from a secondary (reduced) pressure space.

Further, said basic body 1 is provided with an output threaded opening 3 used to take away gas at reduced pressure from said secondary space to a not shown second stage. Eventually, said basic body 1 can be provided also with another not shown threaded opening used for connecting a supplementary device and/or a safety valve.

Opposite to the axis of said seat the proper tension controlled system is connected to the basic body 1. The tension controlled system is comprised of a diaphragm represented in this particular embodiment by a resilient tube 4. Said tube 4 is provided with an inner cavity and an external surface of circular, square or multigonal cross-sectional shape. (The square one is shown.)

Said diaphragm is made of a resilient material, e.g. of silicone rubber and is connected by means of a clip or preferably by a cured joint with a connecting face 5 at one end. Said connecting face 5 and said basic body 1 are provided with a threaded joint used to connect said connecting face 5 of said diaphragm with said basic body 1 at one end. Said tube 4 is joined with a closing face 6 at the other end. Said tension controlled system comprises also planchettes 7. Said planchettes 7 are placed longitudinally at the surface of said

resilient tube 4. At one end, said planchettes 7 are anchored in a circular cavity of said basic body 1 which body 1 has said connecting face 5 threaded in it. At the other end said planchettes are mounted in a planchette mount 8.

For an eventual increase in the range of the operational overpressure, it is possible to insert additional planchettes 7 into the sector-formed gaps between the cross-sectional polygonal (square in the example shown) faces 5 and 6 and the surrounding circular cavities formed in the basic body 1 and mount 8, respectively.

Generally, the number of planchettes depends on the specific valve embodiment. Their number can be from 3 to XY. Optimum of their number is 4, both from the manufacture and design reasons. It the number of planchettes is 4, the cross-sectional profile of is a square, if their number is 5, the cross-sectional profile is a pentagon, it their number is 6, the cross-sectional profile is a hexagon, etc. The invention can use any reasonable number of planchettes and the respective cross-sectional profile.

A threaded opening is formed in said closing face 6 to provide for an adjustable positioning of said plug 9 of the throttling device.

To avoid an accidental mechanical damage of the system caused by an excessive overpressure, the system is inserted into a protective pipe 10. The inner wall of said protective pipe 10 forms a stop for moving of planchettes 7 limiting thereby the maximal deformation of said resilient tube 4.

The basic characteristics of said tension controlled pressure reducing valve for gas pressure control, e.g. flow rate

(litres/min), input pressure, output pressure depend on the intended use. The valve is dimensioned in accordance with the specific requirements in accordance with theories known in the prior art.

The specific requirement determine also the materials used , whereby the most common are brass, steel, bronze, titanium etc. The diaphragm can be made of any resilient material, preferably of any rubber. The required life cycle, the gas controlled, and the secondary pressure required impose additional obvious requirements on the pressure use. In the embodiment exemplified, silicon rubber was used.

Operation of said tension controlled pressure reducing valve consists in expansivity of said diaphragm which is embodied by said resilient tube 4. Said resilient tube 4 increases in volume in reaction to input pressure of the gas the gas let in, whereby, said planchettes 7 that are placed longitudinally on the external surface of said resilient tube 4 and that are firmly anchored in said faces 5 and 6 at both ends of said resilient tube 4 bend, whereby, said the distance of both ends of said resilient tube 4 is shortened. Thereby, said plug 9 bears against said seat situated in said basic body 1 and closes the input of primary pressure into the secondary space situated in the firmly connected basic body 1.

An operation cycle begins in the phase when the valve is open, i.e. the diaphragm (a flexible tube with a tetrahedron surface in this example) and the planchettes placed on its surface and anchored in said circular cavities of the basic body 1 and the mount 8 are straight. The primary pressure let in blows up the circular diaphragm and, simultaneously, the planchettes 7 placed on the surface of said diaphragm and anchored in said circular cavities bend, whereby, the distance

between the ends of said anchored planchettes is shortened. The adjustable plug fixed in said closing face 6 reacts on shortening of this distance by closing the input of primary pressure. By take-off of gas at the secondary pressure the pressure in the valve space decreases and the diaphragm releases, whereby, the distance between the ends is prolonged and the plug 9 opens the input opening again, whereby the gas pressure is increased and the cycle is repeated.

Industrial Use

The tension controlled pressure reducing valve according to the present invention will find use especially in the field of breathing apparatuses, where the close circuit breathing apparatuses are mainly two-stage ones. In the first stage air pressure is reduced from the storage bottle pressure, e.g. from 30 MPa, to a lower pressure from 0.1 to 9.0 MPa, preferably from 0.1 to 2.0 MPa more preferably from 0.2 MPa to 1.0 MPa. A not shown second reducing stage can also be attached.

If proper materials are used the valve can be used for any usual gases existing in breathing apparatuses, e.g. air, oxygen, helium, CO_2, NO_2, etc. The specific gases are determined by the intended use of the valve, i.e a simple control, a breathing apparatus, etc.

Claim

1. A tension controlled reducing valve for gas pressure control, characterised in that said valve comprises a diaphragm in the form of a resilient tube (4) which tube (4) is connected with faces (5 and 6), further planchettes (7) placed longitudinally on said tube (4) anchored in said faces (5 and 6) of said tube (4), whereby, said diaphragm controls movement of a plug (9) with regard to a seat of a throttling device.

2. A tension controlled reducing valve for gas pressure control according to Claim 1, characterised in that said resilient tube (4) is of circular, square or polygonal cross-sectional external circumference.

3. A tension controlled reducing valve for gas pressure control according to Claims 1 or 2, characterised in that the number of said planchettes corresponds to the number of external sides of said cross-sectional polygonal resilient tube (4).

4. A tension controlled reducing valve for gas pressure control according to anyone of Claims 1 to 3, characterised in that said primary pressure is from 30 to 40 MPa and/or said secondary pressure is in the range from 0.1 to 9 MPa, preferably from 0.1 MPa, to 2.0 MPa, more preferably from 0.2 to 1.0 MPa.

5. A tension controlled reducing valve for gas pressure control according to anyone of Claims 1 to 4, characterised in that said resilient tube (4) is of silicone rubber.

6. A breathing apparatus using a tension controlled reducing valve for gas pressure control according to anyone of Claims 1 to 5.

Fig. 1

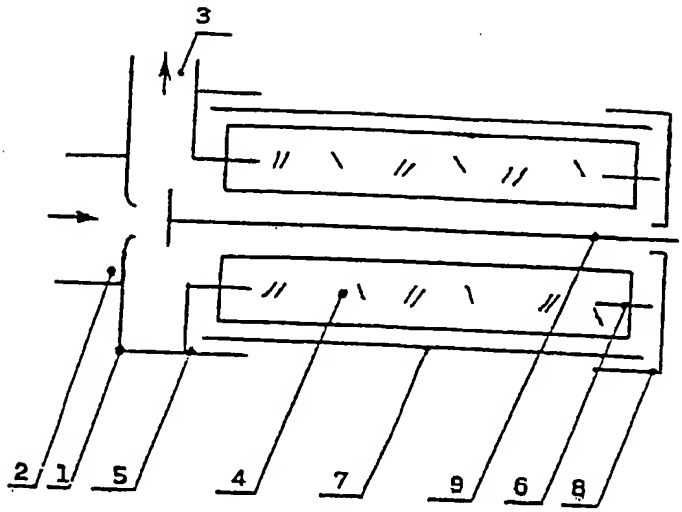


Fig. 2

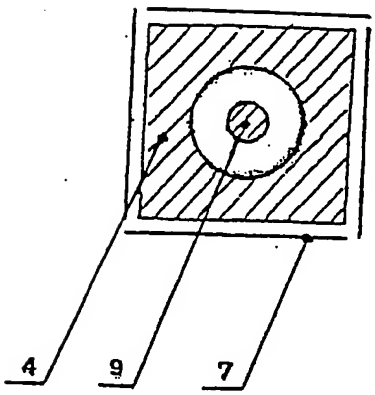


Fig. 3

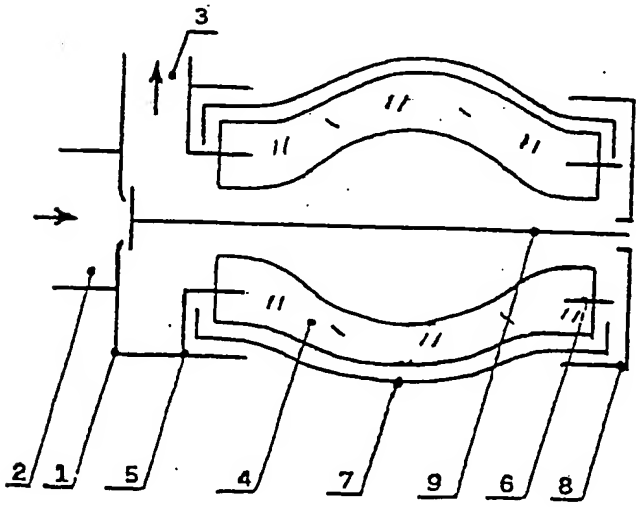
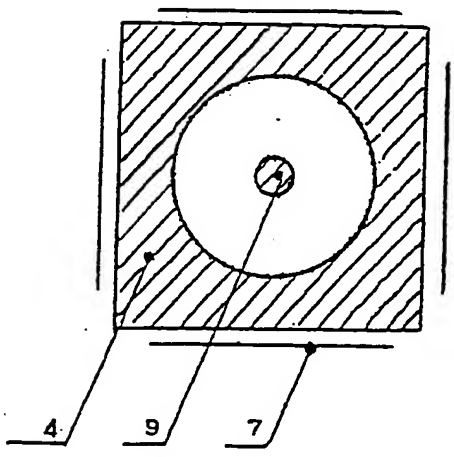


Fig. 4



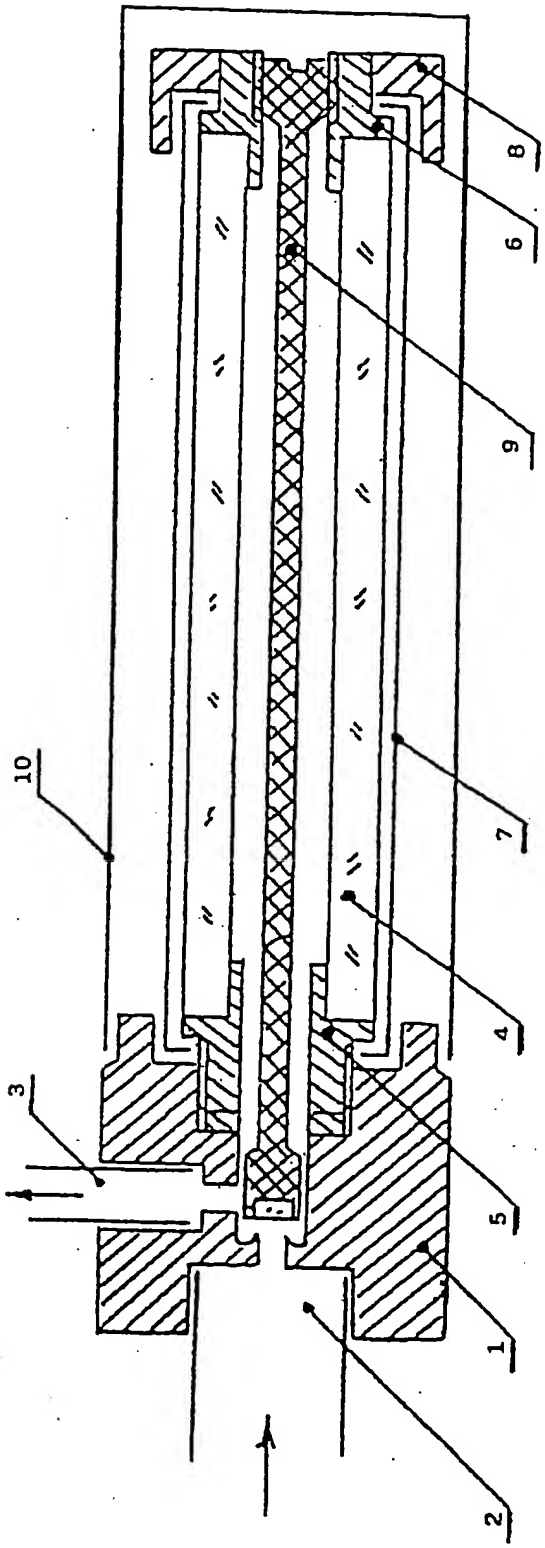


Fig. 5

INTERNATIONAL SEARCH REPORT

Int tional Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G05D16/06 A62B9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G05D A62B A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 512 553 A (MEVA ROUDNICE NAD LABEM) 11 November 1992 (1992-11-11) the whole document	1-6
A	CS 250 347 B (KDER MIROSLAV) 16 April 1987 (1987-04-16) figure 1	1
A	FR 2 620 507 A (MEVA NP) 17 March 1989 (1989-03-17) the whole document	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Information on patent family members

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